

What is claimed is:

1. Fused, crystalline abrasive particle comprising at least 20 percent by volume, based on the total metal oxide volume of said particle, eutectic material,  
5 wherein said eutectic material comprises eutectic of at least:

(a) crystalline  $ZrO_2$  and

(b) at least two of:

(i) crystalline  $Al_2O_3$ ,

(ii) first crystalline complex  $Al_2O_3 \cdot Y_2O_3$ , or

(iii) second, different, crystalline complex  $Al_2O_3 \cdot Y_2O_3$ .

2. The fused, crystalline abrasive particle according to claim 1 comprising at least 50 percent by volume, based on the total metal oxide volume of said particle, of said eutectic material.

3. The fused, crystalline abrasive particle according to claim 2 comprising, on a theoretical oxide basis, at least 40 percent by weight  $Al_2O_3$ , based on the total metal oxide content of said particle.

4. The fused, crystalline abrasive particle according to claim 3, wherein said fused, crystalline abrasive particle further comprises primary crystals of  $Al_2O_3$ .

5. The fused, crystalline abrasive particle according to claim 3, wherein said fused, crystalline abrasive particle comprises colonies of said eutectic, and  
25 wherein said colonies have an average size of less than 100 micrometers.

6. The fused, crystalline abrasive particle according to claim 5, wherein said colonies have an average size of less than 50 micrometers.

005720 0200T950

7. The fused, crystalline abrasive particle according to claim 3, wherein said fused, crystalline abrasive particle comprises colonies of said eutectic, and wherein crystals making up said colonies are, on average, up to 10 micrometers in size.

5 8. The fused, crystalline abrasive particle according to claim 7, wherein said crystals are, on average, up to 1 micrometer in size.

9. The fused, crystalline abrasive particle according to claim 3, wherein said fused, crystalline abrasive particle further comprises at least one of  
10 crystalline rare earth oxide or crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{rare earth oxide}$ .

10. The fused, crystalline abrasive particle according to claim 3, wherein said fused, crystalline abrasive particle further comprises at least one of crystalline  $\text{BaO}$ ,  $\text{CaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $\text{CoO}$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{HfO}_2$ ,  $\text{Li}_2\text{O}$ ,  $\text{MgO}$ ,  $\text{MnO}$ ,  $\text{NiO}$ ,  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  
15  $\text{Na}_2\text{O}$ ,  $\text{Sc}_2\text{O}_3$ ,  $\text{SrO}$ ,  $\text{V}_2\text{O}_3$ ,  $\text{ZnO}$ , or complex  $\text{Al}_2\text{O}_3 \cdot \text{metal oxide}$  thereof.

11. The fused, crystalline abrasive particle according to claim 3, wherein said fused, crystalline abrasive particle has an average microhardness of at least 13 GPa.

20 Sub E2 ~~12.~~ The fused, crystalline abrasive particle according to claim 3, wherein said complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  further comprises cations in addition to Al and Y.

Sub ~~13.~~ The fused, crystalline abrasive particle according to claim 3, wherein a portion of said complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  Al cations are substituted with at least one cation selected from the following cations: Cr, Ti, Sc, Fe, Mg, Ca, Si, and Co.  
25

Sub ~~14.~~ The fused, crystalline abrasive particle according to claim 3, wherein a portion of said complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  Y cations are substituted with at least one cation selected from the following cations: Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sm, Th, Tm, and Yb.  
30

15. The fused, crystalline abrasive particle according to claim 3, wherein a portion of said complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  Y cations are substituted with at least one cation selected from the following cations: Fe, Ti, Mn, V, Cr, Co, Ni, Cu, Mg, Ca, and Sr.

16. The fused, crystalline abrasive particle according to claim 2, said fused, crystalline abrasive particle further comprises primary crystals of  $\text{Y}_3\text{Al}_5\text{O}_{12}$ .

17. The fused, crystalline abrasive particle according to claim 1, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) crystalline  $\text{Al}_2\text{O}_3$ , and (c) crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

18. The fused, crystalline abrasive particle according to claim 17 comprising at least 50 percent by volume, based on the total metal oxide volume of said particle, of said eutectic material.

19. The fused, crystalline abrasive particle according to claim 18 comprising, on a theoretical oxide basis, at least 40 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total metal oxide content said particle.

20. The fused, crystalline abrasive particle according to claim 19, wherein said fused, crystalline abrasive particle comprises colonies of said eutectic, and wherein crystals making up said colonies are, on average, up to 10 micrometers in size.

21. The fused, crystalline abrasive particle according to claim 19, wherein said fused, crystalline abrasive particle further comprises at least one of crystalline  $\text{BaO}$ ,  $\text{CaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $\text{CoO}$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{HfO}_2$ ,  $\text{Li}_2\text{O}$ ,  $\text{MgO}$ ,  $\text{MnO}$ ,  $\text{NiO}$ ,  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{Na}_2\text{O}$ ,  $\text{SrO}$ ,  $\text{Sc}_2\text{O}_3$ ,  $\text{V}_2\text{O}_3$ ,  $\text{ZnO}$ , or complex  $\text{Al}_2\text{O}_3 \cdot \text{metal oxide}$  thereof.

22. The fused, crystalline abrasive particle according to claim 19, wherein said fused, crystalline abrasive particle has an average microhardness of at least 13 GPa.

5 23. The fused, crystalline abrasive particle according to claim 1, wherein said eutectic is eutectic of at least (a) crystalline  $ZrO_2$ , (b) first crystalline complex  $Al_2O_3 \cdot Y_2O_3$ , and (c) second, different, crystalline complex  $Al_2O_3 \cdot Y_2O_3$ .

10 24. The fused, crystalline abrasive particle according to claim 23 comprising at least 50 percent by volume, based on the total metal oxide volume of said particle, of said eutectic material.

15 25. The fused, crystalline abrasive particle according to claim 24 comprising, on a theoretical oxide basis, at least 40 percent by weight  $Al_2O_3$ , based on the total metal oxide content said particle.

20 26. The fused, crystalline abrasive particle according to claim 25, wherein said fused, crystalline abrasive particle comprises colonies of said eutectic, and wherein crystals making up said colonies are, on average, up to 10 micrometers in size.

25 27. The fused, crystalline abrasive particle according to claim 25, wherein said fused, crystalline abrasive particle further comprises at least one of crystalline  $BaO$ ,  $CaO$ ,  $Cr_2O_3$ ,  $CoO$ ,  $Fe_2O_3$ ,  $HfO_2$ ,  $Li_2O$ ,  $MgO$ ,  $MnO$ ,  $NiO$ ,  $SiO_2$ ,  $TiO_2$ ,  $Na_2O$ ,  $SrO$ ,  $Sc_2O_3$ ,  $V_2O_3$ ,  $ZnO$ , or complex  $Al_2O_3 \cdot$  metal oxide thereof.

28. The fused, crystalline abrasive particle according to claim 25, wherein said fused, crystalline abrasive particle has an average microhardness of at least 13 GPa.

29. Fused, crystalline abrasive particle comprising at least 20 percent by volume, based on the total metal oxide volume of said particle, eutectic material, wherein said eutectic material comprises eutectic of at least:

- (a) crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  and  
(b) crystalline  $\text{ZrO}_2$ .

30. The fused, crystalline abrasive particle according to claim 29 comprising at least 50 percent by volume, based on the total metal oxide volume of said particle, of said eutectic material.

31. The fused, crystalline abrasive particle according to claim 30 comprising, on a theoretical oxide basis, at least 40 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total metal oxide content said particle.

32. The fused, crystalline abrasive particle according to claim 30, wherein said fused, crystalline abrasive particle comprises colonies of said eutectic, and wherein crystals making up said colonies are, on average, up to 10 micrometers in size.

33. The fused, crystalline abrasive particle according to claim 30, wherein said fused, crystalline abrasive particle further comprises at least one of crystalline  $\text{BaO}$ ,  $\text{CaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $\text{CoO}$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{HfO}_2$ ,  $\text{Li}_2\text{O}$ ,  $\text{MgO}$ ,  $\text{MnO}$ ,  $\text{NiO}$ ,  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{Na}_2\text{O}$ ,  $\text{SrO}$ ,  $\text{Sc}_2\text{O}_3$ ,  $\text{V}_2\text{O}_3$ ,  $\text{ZnO}$ , or complex  $\text{Al}_2\text{O}_3 \cdot \text{metal oxide}$  thereof.

34. The fused, crystalline abrasive particle according to claim 30, wherein said fused, crystalline abrasive particle has an average microhardness of at least 13 GPa.

35. The fused, crystalline abrasive particle according to claim 30 wherein at least a majority by weight of said crystalline  $\text{ZrO}_2$  is cubic  $\text{ZrO}_2$ .

36. A plurality of particles having a particle size distribution ranging from fine to coarse, wherein at least a portion of said plurality of particles are fused, crystalline abrasive particles comprising at least 20 percent by volume, based on the total metal oxide volume of the respective particle, eutectic material, wherein said eutectic material comprises eutectic of at least:

(a) crystalline  $\text{ZrO}_2$  and

(b) at least two of:

(i) crystalline  $\text{Al}_2\text{O}_3$ ,

(ii) first crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , or

(iii) second, different, crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

37. The plurality of particles according to claim 36, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) crystalline  $\text{Al}_2\text{O}_3$ , and (c) crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

38. The plurality of particles according to claim 36, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) first crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , and (c) second, different, crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

39. A plurality of particles having a particle size distribution ranging from fine to coarse, wherein at least a portion of said plurality of particles are fused, crystalline abrasive particles comprising at least 20 percent by volume, based on the total metal oxide volume of the respective particle, eutectic material, wherein said eutectic material comprises eutectic of at least:

(a) crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  and

(b) crystalline  $\text{ZrO}_2$ .

40. The plurality of particles according to claim 39 wherein at least a majority by weight of said crystalline  $\text{ZrO}_2$  is cubic  $\text{ZrO}_2$ .

41. A plurality of abrasive particles having a specified nominal grade, said plurality of abrasive particle having a particle size distribution ranging from fine to coarse, wherein at least a portion of said abrasive particles is a plurality of fused, crystalline abrasive particles, said fused abrasive particles comprising at least 20 percent by volume, based on the total metal oxide volume of the respective particle, eutectic material, wherein said eutectic material comprises eutectic of at least:

(a) crystalline  $\text{ZrO}_2$  and

(b) at least two of:

(i) crystalline  $\text{Al}_2\text{O}_3$ ,

(ii) first crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , or

(iii) second, different, crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

42. The plurality of abrasive particles according to claim 41, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) crystalline  $\text{Al}_2\text{O}_3$ , and (c) crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

43. The plurality of abrasive particles according to claim 41, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) first crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , and (c) second, different, crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

44. A plurality of abrasive particles having a specified nominal grade, said plurality of abrasive particle having a particle size distribution ranging from fine to coarse, wherein at least a portion of said abrasive particles is a plurality of fused, crystalline abrasive particles, said fused abrasive particles comprising at least 20 percent by volume, based on the total metal oxide volume of the respective particle, eutectic material, wherein said eutectic material comprises eutectic of at least:

(a) crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  and

(b) crystalline  $\text{ZrO}_2$ .

45. The plurality of abrasive particles according to claim 44 wherein at least a majority by weight of said crystalline  $\text{ZrO}_2$  is cubic  $\text{ZrO}_2$ .

Sub 15  
5  
46. A method for making fused, crystalline abrasive particles comprising at least 20 percent by volume, based on the total volume of the respective particle, eutectic material, wherein said eutectic material comprises eutectic of at least (a) crystalline  $ZrO_2$  and (b) at least two of (i) crystalline  $Al_2O_3$ , (ii) first crystalline complex  $Al_2O_3 \cdot Y_2O_3$ , or (iii) second, different, crystalline complex  $Al_2O_3 \cdot Y_2O_3$ , said method comprising:

melting at least one  $Al_2O_3$  source, at least one  $Y_2O_3$  source, and at least one  $ZrO_2$  source to provide a melt; and

10 converting the melt to said fused, crystalline abrasive particles.

38  
47.

38  
The method according to claim 38, wherein converting includes:

cooling the melt to provide a solidified material; and  
crushing the solidified material to provide said fused,  
crystalline abrasive particles.

15

39  
48.

38  
The method according to claim 47, wherein cooling the melt includes cooling the melt with metallic plates.

20

40  
49.

38  
The method according to claim 47, wherein cooling the melt includes cooling the melt with metallic balls.

25

41  
50.

37  
The method according to claim 46, wherein said eutectic is eutectic of at least (a) crystalline  $ZrO_2$  (b) crystalline  $Al_2O_3$ , and crystalline complex  $Al_2O_3 \cdot Y_2O_3$ .

30

42  
51.

37  
The method according to claim 46, wherein said eutectic is eutectic of at least (a) crystalline  $ZrO_2$ , (b) first crystalline complex  $Al_2O_3 \cdot Y_2O_3$ , and (c) second, different, crystalline complex  $Al_2O_3 \cdot Y_2O_3$ .



52. A method for making fused, crystalline abrasive particles comprising at least 20 percent by volume, based on the total volume of the respective particle, eutectic material, wherein said eutectic material comprises eutectic of at least (a) crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  and (b) crystalline  $\text{ZrO}_2$ , said method comprising:  
5 melting at least one  $\text{Al}_2\text{O}_3$  source, at least one  $\text{Y}_2\text{O}_3$  source, and at least one  $\text{ZrO}_2$  source to provide a melt; and  
converting the melt to said fused, crystalline abrasive particles.

53. An abrasive article comprising a binder and a plurality of  
10 abrasive particles, wherein at least a portion of said abrasive particles are fused, crystalline abrasive particles comprising at least 20 percent by volume, based on the total volume of the respective particle, eutectic material, wherein said eutectic material comprises eutectic of at least:

(a) crystalline  $\text{ZrO}_2$  and

(b) at least two of:

(i) crystalline  $\text{Al}_2\text{O}_3$ ,

(ii) first crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , or

(iii) second, different, crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

54. The abrasive article according to claim 53, wherein said article is a coated abrasive article, and further comprises a backing.

55. The abrasive article according to claim 53, wherein said article is a bonded abrasive article.

56. The abrasive article according to claim 53, wherein said article is a nonwoven abrasive article, and further comprises a nonwoven web.

57. The abrasive article according to claim 53, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) crystalline  $\text{Al}_2\text{O}_3$ , and (c) crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

49  
58. The abrasive article according to claim 52, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) first crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , and (c) second, different, crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

5  
59. An abrasive article comprising a binder and a plurality of abrasive particles, wherein at least a portion of said abrasive particles are fused, crystalline abrasive particles comprising at least 20 percent by volume, based on the total volume of the respective particle, eutectic material, wherein said eutectic material  
10 comprises eutectic of at least:

- (a) crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  and
- (b) crystalline  $\text{ZrO}_2$ .

51  
60. The abrasive article according to claim 59 wherein at least a  
15 majority by weight of said crystalline  $\text{ZrO}_2$  is cubic  $\text{ZrO}_2$ .

52  
61. A vitrified bonded abrasive article comprising a plurality of abrasive particles bonded together via vitrified bonding material, wherein at least a portion of said plurality of abrasive particles are fused, crystalline abrasive particles  
20 comprising at least 20 percent by volume, based on the total volume of the respective particle, eutectic material, wherein said eutectic material comprises eutectic of at least:

- (a) crystalline  $\text{ZrO}_2$  and
- (b) at least two of:
  - (i) crystalline  $\text{Al}_2\text{O}_3$ ,
  - (ii) first crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , or
  - (iii) second, different, crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

53  
62. The vitrified bonded abrasive article according to claim 61,  
30 wherein said vitrified bonding material comprises silica, alumina, and boria.

54  
63. The vitrified bonded abrasive article according to claim 62,  
wherein said vitrified bonding material comprises at least 10 percent by weight of said alumina.

5 53  
64. The vitrified bonded abrasive article according to claim 63,  
wherein said vitrified bonding material comprises at least 10 percent by weight of said boria.

10 56  
65. The vitrified bonded abrasive article according to claim 61,  
wherein said eutectic is eutectic of at least (a) crystalline  $ZrO_2$ , (b) crystalline  $Al_2O_3$ ,  
and (c) crystalline complex  $Al_2O_3 \cdot Y_2O_3$ .

15 57  
66. The vitrified bonded abrasive article according to claim 61,  
wherein said eutectic is eutectic of at least (a) crystalline  $ZrO_2$ , (b) first crystalline  
complex  $Al_2O_3 \cdot Y_2O_3$ , and (c) second, different, crystalline complex  $Al_2O_3 \cdot Y_2O_3$ .

20 58  
67. A vitrified bonded abrasive article comprising a plurality of  
abrasive particles bonded together via vitrified bonding material, wherein at least a  
portion of said plurality of abrasive particles are fused, crystalline abrasive particles  
comprising at least 20 percent by volume, based on the total volume of the respective  
particle, eutectic material, wherein said eutectic material comprises eutectic of at least:  
(a) crystalline complex  $Al_2O_3 \cdot Y_2O_3$  and  
(b) crystalline  $ZrO_2$ .

25 59  
68. The vitrified bonded abrasive article according to claim 67,  
wherein at least a majority by weight of said crystalline  $ZrO_2$  is cubic  $ZrO_2$ .

30 Sub E3 58  
69. A method of abrading a surface, said method comprising:  
contacting at least one fused, crystalline abrasive particle  
comprising at least 20 percent by volume, based on the total volume of the respective  
particle, eutectic material, wherein said eutectic material comprises eutectic of at least

(a) crystalline  $\text{ZrO}_2$  and (b) at least two of (i) crystalline  $\text{Al}_2\text{O}_3$ , (ii) first crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , or (iii) second, different, crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , with a surface of a workpiece; and

5 moving at least of one said fused abrasive particle or said surface relative to the other to abrade at least a portion of said surface with said fused abrasive particle.

61  
70. The method according to claim ~~69~~<sup>60</sup>, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) crystalline  $\text{Al}_2\text{O}_3$ , and (c) crystalline  
10 complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

62  
71. The method according to claim ~~69~~<sup>60</sup>, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) first crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , and  
15 (c) second, different, crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

Sub E4  
72. A method of abrading a surface, said method comprising:  
contacting at least one fused, crystalline abrasive particle  
comprising at least 20 percent by volume, based on the total volume of the respective  
particle, eutectic material, wherein said eutectic material comprises eutectic of at least  
20 (a) crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  and (b) crystalline  $\text{ZrO}_2$ , with a surface of a  
workpiece; and  
moving at least of one said fused abrasive particle or said surface  
relative to the other to abrade at least a portion of said surface with said fused abrasive  
particle.

64  
73. The method according to claim ~~72~~<sup>63</sup>, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) crystalline  $\text{Al}_2\text{O}_3$ , and (c) crystalline  
25 complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

~~65  
74.~~

~~63~~  
n 72, wh

74. The method according to claim 72, wherein said eutectic is eutectic of at least (a) crystalline  $\text{ZrO}_2$ , (b) first crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , and (c) second, different, crystalline complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

5

add  $D_1$

add ~~\_\_\_\_\_~~  
Fg

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☒ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**